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Estimation of the firm's balance sheet channel effects during the economic crisis: Case of Croatia

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Abstract
Economic theory recognizes the importance of the firm's balance sheet channel. This stands in stark contrast to the neoclassical theory of investment. This paper analyses the response of firms to the economic crisis in the sample of Croatian firms. Our main variables of interest are investment and employment. We estimated the OLS model that accounts for a heterogeneous response to the crisis shock of differently leveraged firms. The empirical model is augmented so that it accounts for industry and county effects. The robustness checks are performed for different dependent as well as control variables and interactions. The results strongly and robustly confirm the importance of the firm's balance sheet channel.

Keywords: firm balance sheet channel, firm level data, investment equation, investment ratio, robustness check.

JEL classification: E22, E24, G32, E32.
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Introduction
Using Croatian firm-level data, this paper investigates to which extent the financial and liquidity position contributed to the development of investment and employment at the firm-level during the period 2007-10. According to the theory of firm`s balance sheet channel, the firm's response to demand shocks depends on the firm's balance sheet characteristics. Our empirical approach aims at assessing the extent to which the firms that were highly leveraged before the crisis reduced investment and employment more than firms with lower leverage but otherwise similar characteristics. Therefore, the main research questions in this paper are: 1) Did the high-debt and/or the low liquid firms experience larger decrease of investment and employment during the Great recession?; 2) Are the results sensitive to the choice of balance sheet controls and different time span of analysis?

The rest of the study is structured as follows: Section 2 gives the literature overview and discusses recent developments in the research on the firm balance channel. Section 3 describes the data set, the construction of our empirical sample and discusses the variables used in the empirical analysis. The methodology and empirical model are explained in the Section 4. The Section 5 shows the results and the respective discussion. The last chapter concludes.

Literature review

According to the neoclassical theory of investment, the Tobin Q (Hayashi, 1982) contains the full information about investment dynamics, while financial variables, like financial leverage or liquidity don't have any effect on firm`s investment behaviour. Firm's capital structure is therefore irrelevant (Modigliani, Miller, 1958) and capital can freely fly from unproductive to productive agents. This view implies perfect capital markets and can be denoted as "irrelevance view" (Schularick, Taylor, 2011).

On the other side, even before financial crisis, some papers argued that business cycles dynamics and investment of non-financial firms might also depend on financial variables, like firm's net worth or collateral (Bernanke, Gertler, 1989; Carlstrom, Fuerst, 1997; Kiyotaki, Moore, 1997; Bernanke, Gertler, Gilchrist, 1999; Tirole, 2006). This channel is known as firm's balance sheet channel or the investment channel of financial frictions. In these models, investment is a positive function of the firm's net worth because the greater the net worth of the borrower, the more likely she will use self-financing as a way to fund investment. At the same time, higher net worth leads to decrease in credit rationing, so firms have easier access to external finance.

Papers that emphasize the role of household's balance sheets or consumption channel of financial frictions are Mian and Sufi (2010, 2014), Eggertson and Krugman (2012). Some papers point to the role of financial intermediary balance sheets (see, Chodorow-Reich, 2014; Gertler, Kiyotaki, 2011; Brunnermeier, Sannikov, 2014).

Many papers (see Hubbard (1988) and Stein (2003) for the literature survey) empirically assess the degree of financial constraints for non-financial firms. This literature usually divides firms in three groups according to some balance sheet variable i.e. criteria, and then estimates the sensitivity of investment to cash flows for every group. The monotonically increasing sensitivity in the balance sheet variable than implies that high-debt firms are financially constrained. Fazzari and Petersen (1993) were first that apply this approach to find the evidence for financial constraints.

Many authors criticized the investment-cash flow sensitivity approach. Two critiques are the most common: 1) endogeneity problem and 2) measurement error in Q. The first critique is particularly important because the positive sensitivity of investment and cash flows can be a sign of higher investment opportunities, not financial constraints. To overcome the endogeneity problem, some authors suggest quasi-experimental methods (treatment effects) analysing the existence of financially constrained firms (Calomiris, Hubbard, 1995; Blanchard, Lopez-de-Silanes, Schleifer, 1994; Lamont, 1997; Rauh, 2006; Almeida et al., 2012; Lemmon, Roberts, 2010). An alternative approach is to use survey methods (see Campello et al., 2010; Šonje, Kukavčić, 2014). The second critique points to the possibility of an upward bias in Q. Namely, the estimated coefficient on Q is larger than in standard investment regression function (Kaplan, Zingales, 1997; Erickson, Whited, 2000; Gomes, 2001; Alti, 2003; Cleary, Povel, Raith, 2007; Farre-Mensa, Ljungqvist, 2016).

Our research builds on the concept of balance sheet recession and is closely related to the empirical research of the firm´s balance sheet channel during the crisis (Kuchler, 2015; Giroud, Mueller, 2015). According to the theory of balance sheet recession, high levels of private sector debt change the objective function of the corporate sector from profit maximizing to debt minimizing (paying down debt) that cause less spending and economic growth (Koo, 2009). Firms may prefer to reduce leverage instead of investing accordingly. On the empirical side, Kuchler (2015) confirmed that high-levered firms in Denmark experienced higher decrease in investment relative to low-levered firms. Giroud and Mueller (2015) showed that establishments of firms that tightened their debt capacity in the run-up to the Great Recession (high-leverage firms) exhibit a significantly larger decline in employment in response to household demand shocks than low leverage firms.

Data and descriptive evidence

Our data sample consists of all joint-stock, limited liability and handicraft companies in Croatia and is collected from the data repository of Financial Agency (FINA). We have almost the full population of firms in the country (N=990.908, T=15) available for our empirical analysis. We are interested in tracking firm's change of investment and employment behaviour throughout the economic crisis. The economic crisis represents the biggest and longest macroeconomic shock for Croatian firms in the last 15 years and we use it as an event that made firms behave in a non-standard way. Since we are interested in the firm´s behaviour during the crisis, the period of the analysis is from 2007 to 2010. The crisis effects were strongest during that period which is confirmed by robustness tests that we run for alternative crisis years (2007-2008 and 2007-2009).

In the construction of our empirical dataset, we exclude following sectors: banking, financial intermediation, mutual funds, holding financial companies and insurance, education, public sector and defence, social insurance as well as publicly owned companies. Next, the data set was cleaned from outliers as regarding to: 1) the firms with 0 HRK value of assets, sales, cash balances or employees, 2) the firms with sales, depreciation and debt to assets ratios higher than 99th percentile, 3) the firms where cash flow to assets ratio, investment, sales growth, value added to asset ratio, ROA, current ratio and debt ratio are lower than 1th or higher than 99th percentile, 4) the firms with missing observations and the inactive firms.

These exclusions reduce the heterogeneity of the sample and make the implications of our analysis more reliable. After these adjustments, our baseline specification (period from 2007-2010) consists of 18.235 observations for the investment equation and 31.137 for the employment equation. We first make the balanced panel from 2007 to 2010 and then we use the data on investment and employment from 2007 and 2010 to construct our dependent variable: log change in investment (employment). The statistical summary of our data set is provided in the Appendix (Table A8).

The aim of our analysis is to compare firm´s behaviour of investment and employment in relation to different levels of leverage and liquidity. Leverage is defined as the ratio of debt to total assets (debt ratio) where we define three categories of leverage, namely low-leverage firms (up to 33th percentile), medium-leverage (between 33th and 66th percentile) and high-leverage (above 66th percentile). The liquidity is measured by current ratio (short-term asset/short-term liabilities). Similarly, there are three groups of firms: low-liquid firms (up to 33th percentile), medium-liquid (between 33th and 66th percentile) and high-liquid (above 66th percentile).

The main variables of our interest are the investment and employment. We define investment as a nett difference of depreciation augmented tangible assets (MI) in the current period and nett tangible assets in the previous period, $\mathrm{i_t} = (\mathrm{MI_t} + \mathrm{A_t}) - \mathrm{MI_{t-1}}$. As a robustness check, the alternative measure from Croatian Bureau of statistics is used as a measure of investment, namely the investment in new long-term assets. Employment is equal to the log of number of employees or total hours worked in the each firm.

Our empirical model includes the vector of control variables typically found in investment models. The first one is the cash flow rate cf_t and it is intended to proxy for the firm`s nett value. The cash flow is defined as a sum of pre interest and tax profits and depreciation. The second control that we include in our model is the new value added rate nva_t. The new value added controls for the general output effect on the firm level and we calculate it as a sum of pre-tax, interest and employee expenditure earnings. The third variable we include in our vector of controls is the depreciation rate dr_t and is defined as the ratio of depreciation and total assets in the previous period. The last control variable is the return on assets roa_t and is defined as the ratio of gross earnings and the price-corrected total assets. To control for the differences in industries and counties, we include county $(C_c, c = 1,..21)$ and industry $(S_s, s = 1, \dots, 18)$ dummies in our empirical specification as well. This accounts for the potential heterogeneities related to the type of business and geographical factors of the sample. We use industry classification given by National industry classification (18 industries all together).

Next, we provide descriptive analysis of variables used in the analysis. Balance sheet recession implies the positive feedback loop between debt and business investment in a boom phase of the business cycle and the asymmetric responses to the negative shock (recessions) due to the different firm indebtedness. Consequently, to get an impression of the aggregate debt and investment dynamics, we present a time period (2000-2014) which is longer than in our empirical model on the Figures 1 and 2. Several definitions of investment (i.e. investment variables) are used in this paper. The first one is investment cash flow obtained from the cash flow accounts. This variable represents both real and financial investment. Second variable is gross capital formation derived from Croatian Bureau of Statistics. The third variable is the nett investment and represents the nett tangible assets change $MI_t - MI_{t-1}$.

All three variables show similar dynamics and statistical properties (Figure 1). All measures of aggregate investment in Croatia exhibit typical boom and bust behaviour, which can be seen on the Figure 1. The investment increased from 23 billion HRK in 2001 to 69 billion in 2007, which is CAGR of 20%. After the financial crisis, investment decreased continuously to the level of 25 billion HRK in 2014, which is a slump of 62.88%. Gross capital formation and investment flow shows a smaller decrease (53% and 57% in period 2008-2014), but the pattern is similar.

Aggregate dynamics of capital structure for the period 2000-2014 is shown in the Figure 2. The boom phase of the business cycle (2000-2007) is characterized by the increase in aggregate financial leverage. The structure of debt has changed over time as well. While short–term debt is relatively constant in the pre-crisis period, long-term debt increases significantly. As a result, the debt ratio rose from 50% in 2000 to 55% in 2007 and 60% in 2011. It is interesting to note that the debt ratio increased even after the crisis. However, after 2012 there is a small deleverage from 61.02% to 59.60%.

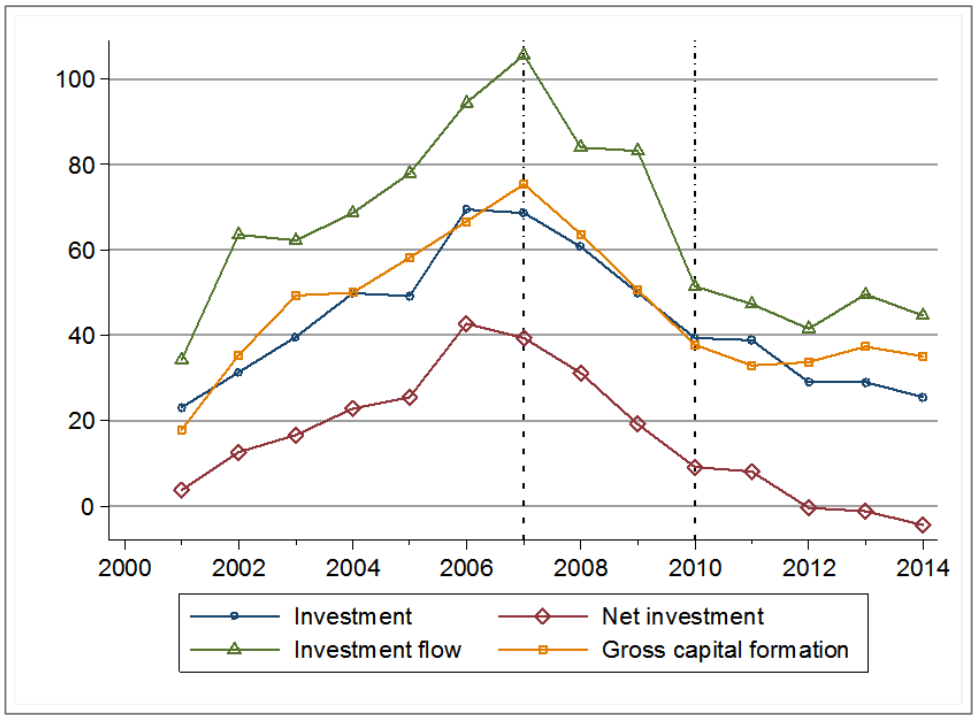

Figure 1 Investment, gross capital formation, investment flow and net investment of non-financial firms in period 2001-2014, in billions HRK; the period between the two (dotted) lines is used in our empirical model since the crisis was most intense during that time

Source: FINA, author's calculation.

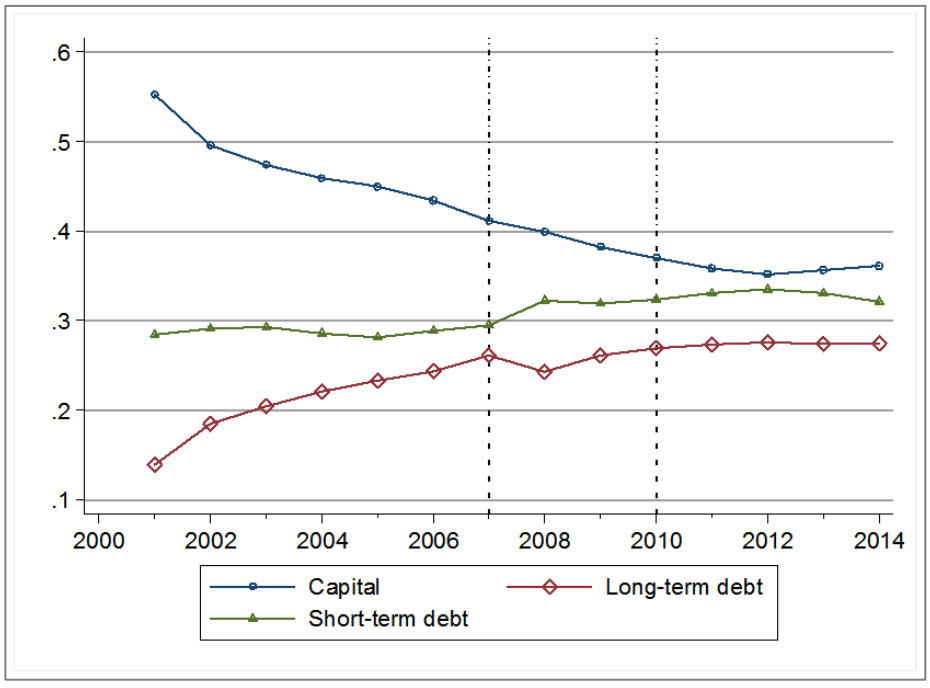

Figure 2 Capital structure dynamics from 2000 to 2014; the period between the two (dotted) lines is used in our empirical model since the crisis was most intense during that time

Source: FINA, author's calculation.

It is important to mention that the short- and long-term debt includes liabilities to related parties so that this position more resembles capital than debt. When the debt

ratio is adjusted in a way that liabilities to related parties are subtracted from debt and added to capital, the dynamics of debt ratio looks different. This adjusted debt ratio is mainly unchanged from 2008 to 2014, which means that the whole increase in the debt ratio from 2008-2014 is due to the rise in labilities to related parties. This might imply the problem in firm´s access to finance and financial constraint.

Continuing our descriptive analysis, we split the sample by lag debt ratio, lag current ratio, lag value added ratio and lag cash flow ratio. First group ("Low") includes firms, which has lag debt ratio to 33th percentile; second group ("Middle") includes firms from 33th to 66th percentile and third group above 66th percentile. For every group we calculate the median of investment. The same procedure for other variables was used. We note that the percentile thresholds are imposed exogenously (not generated from a pre-specified or data-driven approach) and are chosen so that they follow best practices in the literature (see Tarrasow, 2015; Kuchler, 2015).

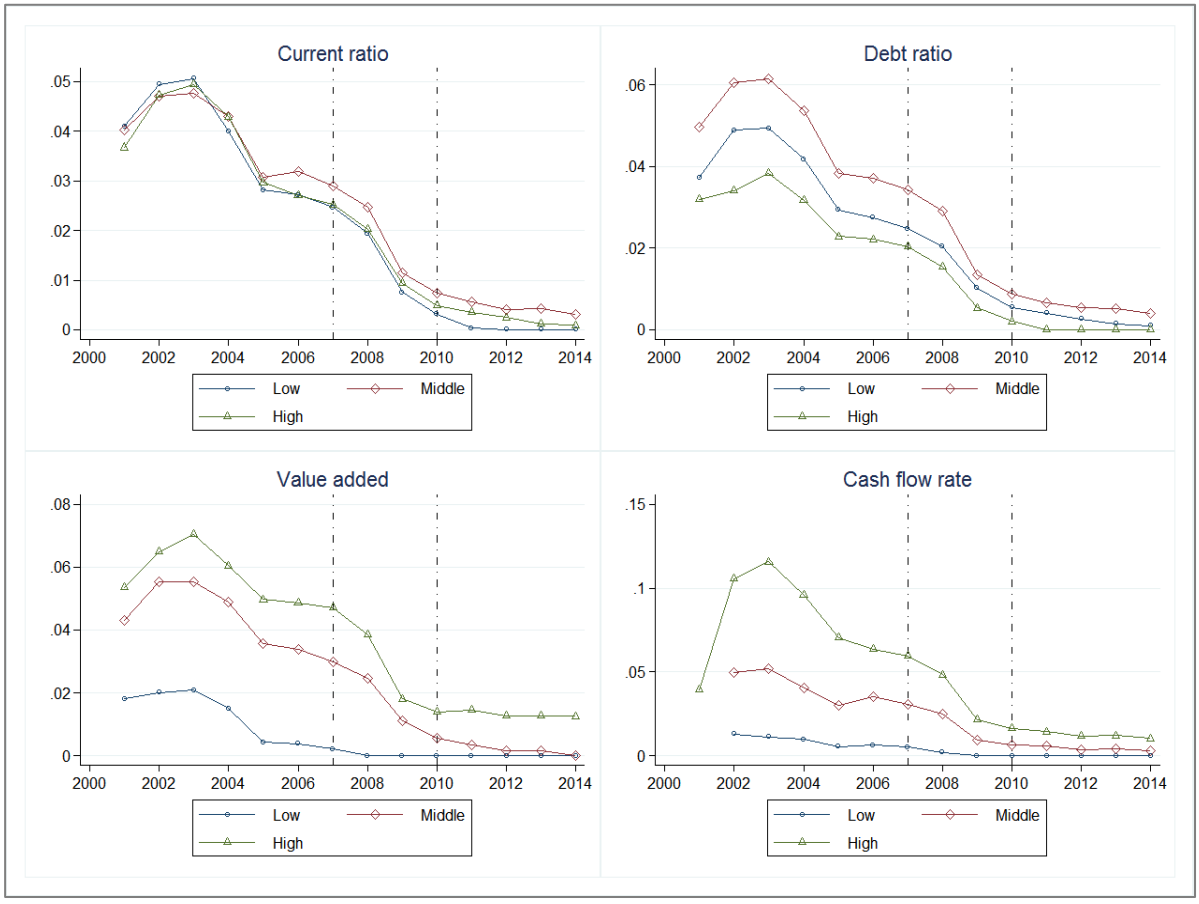

Figure 3 Median of investment ratio dynamics for different groups of firms from 2001 to 2014

Source: FINA, author's calculation.

All graphs in the Figure 3 show decline in investment for all groups and variables. The first graph on the Figure 3 shows that illiquid firms invest less than middle and high-liquid firms. Even larger difference between median of investment across groups is visible on second graph. Firms with high debt ratio (above 66th percentile) have smaller investment ratio than other two groups. It is interesting to note that median of investment for "high" group shows negative trend and settled at 0 in 2009. Firms with "low" leverage invest more than with "middle" leveraged firms, but "middle" leveraged firms experienced a larger decline in debt. This reflects the dual

role of the debt, meaning that it is an important source of financing on one side and a generator of higher risk on another side.

Last two graphs show median of investment rates for variables that reflect demand side factors. There is a clear hierarchical structure in the investment behaviour. The firms with "low" cash flow and low value added rates have 0 investment ratio throughout the whole period. The firms with "middle" level of cash flow or value added shows decrease from 0.2 to 0, while "high group" exhibit highest investment rates.

Methods

In order to determine the effects of the leverage and the liquidity on the investment and the employment, the OLS estimator is applied to the following reduced form of the investment equation:

$$\Delta Y_{i,s,c,2007-2010} = \alpha + \theta_L L_{i,s,c,2007} + \theta_H H_{i,s,c,2007} + \theta_D H_{i,s,c,2007} \cdot L_{i,s,c,2007} + \beta \boldsymbol{X}_{i,s,c,2007} + \sum_{s=1}^{17} \varphi_s S_s + \sum_{c=1}^{20} \omega_c C_c + e_{i,s,c,t} \quad (1)$$

where the subscripts refer to firm $i = 1, \dots, i$, industry $s = 1, \dots, s$, county $c = 1, \dots, c$, the subscript *2007-2010* refers to the change over the respective period and *2007* denotes stands for the value in the initial sample year. The depended variable ($\Delta Y_{i,s,c,2007-2010}$) represents the change of net investment for each firm *i*, industry *s* and county c, from 2007 to 2010. The change in the number of persons employed in each firm from 2007 to 2010 as the dependent variable was used as well. The L and the H are the balance sheet dummy variables denoting the debt and current ratio. Therefore, the L and the H refer to firms having low/high debt ratio, or low/high current ratio where the respective subscript *2007* refers to the value at the beginning of the period (i.e. year 2007). More precisely, the dummy variable L is equal to one if a firm's debt ratio or current ratio is inside 33th percentile (low-leverage and low-liquid firms). The dummy variable H is equal to one if a firm's debt ratio or current ratio is above 66th percentile (high-leverage and high-liquid firms). The middle-leverage or the middle-liquid group represents the base group. The estimated coefficients θ_L and θ_H contain the information about the difference in the change of investment rates (employment) between low and medium, and high and medium levered (or liquid) firms. Coefficient on interaction term θ_D, measures the average difference in change of investment rates between low-leverage-high-liquid firms relative to middle-leverage-middle-liquid (Wooldridge, 2010). The first summation sign, $\sum_{s=1}^{17} \varphi_s S_s$, represents industry fixed effects.

There are 18 industries in total, where agriculture represents the base industry. Second summation sign represents county fixed effects. There are totally 21 counties and Zagrebacka zupanija county represents the base county. Number of industries and counties are decreased by one due to the dummy variable trap.

The Vector $\boldsymbol{X}$ includes the set of control variables: cash flow, new value added rate, depreciation rate, real sales growth and return on assets (see previous section for the discussion). All control variables, except Return of Assets (ROA) and real sales growth are normalized by total assets size for the sake of comparability.

Results and implications

The estimation results are presented in Tables 1 and 2. The Table 1 shows the results where change in investment is used as the depended variable. The coefficients on low-leverage and high-leverage dummy variable measure the average difference in investment between low-leverage (debt ratio <0.49) and middle-leveraged (debt

ratio between 0.50 and 0.76), and high-leverage (debt ratio > 0.76) and middle leverage firms respectively, holding other firm's characteristics fixed. There are 6017 middle, 6018 low and 6200 high leveraged firms retrospectively and 6019 middle, 6017 low, 6199 high liquid firms. On average, decrease in investment for low-leverage firms is11.3% higher than for middle-leverage (base group), while high-leverage experience 7.64% lower change in investment (significant at 10% level). After including sector and county dummies (model 2), the coefficient on low-leverage dummy is still significant at 10% level but the coefficient on high-leverage dummy becomes insignificant at 10% level.

Table 1 Change in investment from 2007 to 2010

Variables	(1)	(2)	(3)	(4)	(5)
Low-leverage	0.113***	0.0983*			-0.160**
	(0.0411)	(0.0520)			(0.0651)
High-leverage	-0.0746*	-0.0708			0.000765
	(0.0415)	(0.0434)			(0.0708)
Low-liquidity			-0.234***	-0.237***	-0.260***
			(0.0416)	(0.0298)	(0.0412)
High-liquidity			0.0351	0.0280	-0.164***
			(0.0412)	(0.0433)	(0.0497)
L-lev*L-liq					0.252*
					(0.121)
L-lev* H-liq					0.378***
					(0.0684)
H-lev*L-liq					-0.0192
					(0.0602)
H-lev*H-liq					0.119
					(0.133)
nva	0.0694*	0.0657	0.0776**	0.0695*	0.0672*
	(0.0390)	(0.0411)	(0.0391)	(0.0390)	(0.0368)
cfl	1.385***	1.375**	1.494***	1.463**	1.365**
	(0.402)	(0.525)	(0.401)	(0.542)	(0.535)
dr	-2.912***	-2.969***	-2.785***	-2.897***	-2.730***
	(0.434)	(0.574)	(0.657)	(0.606)	(0.600)
rsg	-0.000162	-0.000119	-0.000161	-0.000108	-9.49e-05
	(0.000176)	(9.83e-05)	(0.000175)	(9.86e-05)	(9.64e-05)
roa	-0.0146***	-0.0140***	-0.0160***	-0.0152***	-0.0146***
	(0.00331)	(0.00426)	(0.00331)	(0.00448)	(0.00436)
Constant	-0.778***	-0.480***	-0.717***	-0.399***	-0.372***
	(0.0366)	(0.0532)	(0.0409)	(0.0583)	(0.0592)
Observations	18,235	18,235	18,235	18,235	18,235
R-squared	0.006	0.013	0.008	0.015	0.015
Industry effects		YES		YES	YES
County effects		YES		YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Coefficients on low- and high-liquidity, in columns (3) and (4) in the Table 1, measure the average difference of a change in investment between low-liquid (current ratio < 1.07) and a middle-liquid (current ratio between 1.08 and 1.80) firms, and high-liquid (current ratio > 1.81) and middle-liquid firms retrospectively, holding other firm's characteristics fixed. The results show that change in investment for low-

liquid firms are 23% lower than the middle leverage firms on average (highly significant), while coefficient on high-levered firms is insignificant. The column (5) from the Table 1 includes the interaction terms between leverage and liquidity to estimate reaction of financially distressed firms. The results confirm the importance of the firm balance sheet channel: firms with weaker balance sheets experienced a larger drop in investment. For example, for the low-leverage-high-liquid firms change in investment is 5.8% higher on average, relative to middle-leverage-middle-liquid firms do. On the other side, high-leverage-low-liquid firms invest on average 28% less than middle-leverage-middle-liquid firms do.

Overall, the results indicate that the medium and high leveraged firms reduced their investment more during the crisis than firms with low leverage did. The drop in investment is even stronger if we relate low-liquid and middle-liquid (or high-liquid) firms.

Table 2 Change in employment from 2007 to 2010

Variables	(1)	(2)	(3)	(4)	(5)
Low-leverage	0.0279***	0.0213***			0.00807
	(0.00624)	(0.00394)			(0.0171)
High-leverage	-0.0314***	-0.0308***			-0.0101
	(0.00690)	(0.0104)			(0.00608)
Low-liquidity			-0.0341***	-0.0326***	-0.0235
			(0.00696)	(0.00587)	(0.0225)
High-liquidity			0.0225***	0.0162*	0.0159
			(0.00634)	(0.00778)	(0.0109)
L-lev*L-liq					0.00888
					(0.0380)
L-lev* H-liq					-0.000874
					(0.0177)
H-lev*L-liq					-0.00951
					(0.0216)
H-lev*H-liq					-0.0705***
					(0.0209)
nva	-0.0377***	-0.0448***	-0.0354***	-0.0434***	-0.0446***
	(0.00544)	(0.0116)	(0.00543)	(0.0113)	(0.0113)
cfl	0.186**	0.181**	0.214***	0.205**	0.179*
	(0.0727)	(0.0850)	(0.0738)	(0.0862)	(0.0861)
dr	0.162**	0.149*	0.153	0.145*	0.174**
	(0.0760)	(0.0790)	(0.107)	(0.0761)	(0.0737)
rsg	0.000219***	0.000245***	0.000209***	0.000237***	0.000249***
	(3.14e-05)	(3.80e-05)	(3.11e-05)	(4.10e-05)	(3.82e-05)
roa	0.000785	0.000822	0.000549	0.000617	0.000748
	(0.000592)	(0.000575)	(0.000603)	(0.000590)	(0.000585)
Constant	-0.154***	-0.120***	-0.155***	-0.118***	-0.116***
	(0.00585)	(0.00877)	(0.00641)	(0.0126)	(0.0145)
Observations	31,137	31,137	31,137	31,137	31,137
R-squared	0.021	0.035	0.021	0.035	0.036
Industry effects		YES		YES	YES
County effects		YES		YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Table 2 shows the results for the model that has a change in employment as a depended variable. The high-leverage and low-liquid firms have on average around 3% lower change of employment then the baseline group (significant at 1% level). Again, the largest decline is characteristic for high-debt-low-liquid firms, around 4% lower than the baseline group.

As a robustness test, we provide results for different definitions of investment and employment variable in the Table A1 and the Table A2 (see Appendix). We use the gross investment in new long-term assets on the firm level as a measure of investment, according to the definition in the national account statistics. The hours worked (on the firm level) is used as a measure of employment. In the Table A1 the direction of relationship between investment and balance sheet variables is the same for low liquid firms (around -21%), but lower for high debt firms (-4%, but insignificant). On the other hand, the results in the appendix Table A2 are almost the same as in the Table 2, which means that there is no difference in results when hours worked is used as a dependent variable compared to the number of employees.

It is important to note that our results might suffer from a slight downward-bias due to the bankruptcy rate increase after the crisis, which affects our data. Namely, the firms that went bankrupt have not submitted annual reports after the crisis. For these firms, the decrease in employment and investment is equal to 100%. It is reasonable to expect that these firms belong to high-leveraged or low-liquid firms. Since they did not submit financial statements in 2010, they are not part of our analysis.

To overcome this problem we also estimate changes in employment and investment for periods 2007-2009 and 2007-2008. The results are given in the Table A3 and the Table A4. In the Table A3, the coefficients on balance sheet dummy variables have the same direction and similar magnitude as the coefficients in baseline model. The only difference comes from a somewhat lower coefficient on low-liquid dummy variable (-15%) and higher coefficients for high-liquid firms. Again, the highest drop in investment is present for high-leverage-low-liquid firms (-20%). The Table A4 shows the different results relative to the baseline model (2007-2010). There is no economically and statistically different employment adjustment behaviour among firms according to balance sheet variables. The reason for this is simple. Namely, the aggregate employment levels started to decrease in 2009 and even more in 2010, so that the effect of change in employment can be seen only after 2009.

As an additional robustness test, we estimate the equation (1) for pre-crisis periods 2005-2006 and 2005-2007 to control for more general effects (other than crisis). The results are provided in the Table A3 (see Appendix). The coefficients on leverage and liquidity dummy variables exhibit the similar pattern before and during the crisis, which indicates that the frictions on capital markets may have also been present before the crisis. On the other side, there is no significant change in employment between high, middle and low-leverage (liquid) firms before crisis. Therefore, it is possible to conclude that there are investment balance sheet effects in all periods and employment balance sheet effects during the crisis.

We also did standard diagnostic and specification checks. Table A9 shows high correlation between cash flow and return on assets, but there is no perfect multicollinearity problem. Removing *roa* from specification changes somewhat coefficients on cash flows and new value added (they become insignificant) but this doesn't change the significance of coefficients on dummy variables. We use robust standard errors in our empirical specification to control for heteroscedasticity, so there is no need to conduct heteroscedasticity test. Outliers are removed by trimming all variables (see "data and descriptive evidence"). Next, we conduct

Shapiro-Wilk (table A10). It shows that our residuals are not normally distributed (the peak of the distribution is higher). But, as Lumley and Emerson (2002) shows, for large samples, t-test and linear regression coefficients are valid for any distribution.

The results have implications for economic policy. They indicate that firms respond to economic shocks in a heterogeneous way which potentially causes protracted recessions and changes the structure of economy. As a reaction to the economic crisis, firms first tighten their investment which is especially the case with highly indebted and exposed businesses. These firms also reduce the employment and add additional pressure to the overall economy creating a negative feedback loops that might further inhibit the economic recovery. This might destroy the equilibrium and lower the steady state of the economy. Policy makers could respond with debt write offs and by offering alternative credit lines (i.e. source of financing). The debt write-offs are therefore expected to have positive effects on employment and shorten the recession. This might be a way to deal with recessions without directly burdening the public finances. Easier access to financing would be especially beneficial to smaller firms and policy makers should provide options for financial inclusion and/or other crediting channels. The policy makers should also consider labour market regulation that preserves employment throughout the period of crisis. Namely, shorter working hours and performance adjusted tax could be considered.

Conclusions

Economic literature recognizes the firm`s balance sheet channel as an important propagator of macroeconomic shocks. This stands somewhat in contrast to the neoclassical theory of investment which assumes perfect capital markets. Firms react heterogeneously to the crisis due to different financial positions. This shows the importance of financial frictions in amplification of negative shocks. This paper analyses the firm's reaction to economic crisis in general and their investment as well as employment decisions in particular. We make use of high-quality, firm level data where almost the whole population of Croatian firms is available for analysis. After the data set adjustments to solve the outlier problems, we are left with 18.235 and 31.137 observations in our empirical sample, depending on the preferred choice of variables. Therefore, we apply simple but powerful OLS estimator where the model can differentiate between the high, medium and low leveraged firms. The model is augmented with a set of commonly used controls as well as county and industry dummies. Unobserved heterogeneity is accounted for with these effects. We run different robustness tests and are able to interpret the results with significant amount of certainty.

There is evidence that confirms the importance of the firm`s balance sheet channel. Namely, the medium and high leveraged firms reduce their investment during the crisis more than the firms with low leveraged balance sheet. On average, high-leverage firms experience 7.64% lower change in investment. The evidence is even stronger for low-liquid firms when compared to high-debt firms. The results show that change in investment for low-liquid firms are 23% lower than the middle leverage firms on average.

This results point to the difference between financial and liquidity constraints, which can serve as a foundation for future theoretical research that emphasizes financial constraints. This finding also holds when the employment is used as a dependent variable and is supported by various additional robustness tests (various time periods, different dependent variables, various independent variables). The analysis has implications for economic policy, especially policies that decrease firm´s debt load through debt forgiveness or higher financial inclusion for small firms.

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APPENDIX

Table A1 Description of variables used in the analysis

Variable name	Abbreviation	Short Description
Investment	*i*	nett difference of depreciation augmented tangible assets
Employment	e	number of employees or total hours worked within a firm
Cash flow	*cf*	sum of pre interest and tax profits and depreciation
New value added	*nva*	sum of pre-tax, interest and employee expenditure earnings
Depreciation rate	*dr*	ratio of depreciation and lagged total assets
Return on assets	*roa*	ratio of gross earnings and the price-corrected total assets
Current ratio	*cr*	Ratio of current assets and short –term liabilities
Leverage	*Lev*	Ratio of total debt and total assets
Revenue growth	*Rsg*	Deflated revenue growth rate

Table A2 Change in investment in new long-term assets from 2007 to 2010

Variables	(1)	(2)	(3)	(4)	(5)
Low-leverage	0.132***	0.129**			-0.122
	(0.0485)	(0.0459)			(0.0925)
High-leverage	-0.0486	-0.0496			0.0373
	(0.0492)	(0.0452)			(0.0714)
Low-liquidity			-0.213***	-0.217***	-0.233***
			(0.0491)	(0.0569)	(0.0721)
High-liquidity			0.0576	0.0596	-0.116
			(0.0487)	(0.0681)	(0.0877)
L-lev*L-liq					0.293*
					(0.151)
L-lev* H-liq					0.339**
					(0.135)
H-lev*L-liq					-0.0492
					(0.0927)
H-lev*H-liq					0.106
					(0.155)
nva	0.315***	0.317***	0.331***	0.320***	0.319***
	(0.0450)	(0.0418)	(0.0452)	(0.0430)	(0.0407)
cfl	1.156*	1.158*	1.215**	1.249**	1.172*
	(0.598)	(0.569)	(0.596)	(0.559)	(0.566)
dr	-2.692***	-2.681***	-4.269***	-2.637***	-2.500***
	(0.618)	(0.577)	(0.857)	(0.534)	(0.539)
rsg	-0.00064***	-0.00062***	-0.00061**	-0.00056**	-0.00054**
	(0.000244)	(0.000201)	(0.000245)	(0.000193)	(0.000204)
roa	-0.0144***	-0.0143***	-0.0155***	-0.0156***	-0.0152***
	(0.00482)	(0.00385)	(0.00482)	(0.00390)	(0.00394)
Constant	-0.801***	-0.531***	-0.667***	-0.452***	-0.448***
	(0.0445)	(0.0908)	(0.0497)	(0.0877)	(0.108)
N	8,979	8,979	8,979	8,979	8,979
R-squared	0.011	0.017	0.014	0.019	0.020
Industry effects		YES		YES	YES
County effects		YES		YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Table A3 Change in hours worked from 2007 to 2010

Variables	(1)	(2)	(3)	(4)	(5)
Low-leverage	0.0230***	0.0169***			0.0111
	(0.00605)	(0.00530)			(0.0161)
High-leverage	-0.0309***	-0.0305**			-0.0141
	(0.00672)	(0.0109)			(0.00956)
Low-liquidity			-0.0302***	-0.0293***	-0.0187
			(0.00678)	(0.00563)	(0.0189)
High-liquidity			0.0206***	0.0152**	0.0161**
			(0.00617)	(0.00580)	(0.00573)
L-lev*L-liq					-0.00679
					(0.0314)
L-lev* H-liq					-0.00798
					(0.0148)
H-lev*L-liq					-0.00742
					(0.0156)
H-lev*H-liq					-0.0526**
					(0.0236)
nva	-0.0399***	-0.0464***	-0.0380***	-0.0451***	-0.0462***
	(0.00522)	(0.00853)	(0.00521)	(0.00840)	(0.00825)
cfl	0.151**	0.146	0.177**	0.168*	0.145
	(0.0685)	(0.0917)	(0.0694)	(0.0931)	(0.0935)
dr	0.234***	0.219**	0.289***	0.216**	0.238***
	(0.0717)	(0.0824)	(0.103)	(0.0783)	(0.0791)
rsg	0.000240***	0.000266***	0.000232***	0.000258***	0.000270***
	(3.01e-05)	(2.91e-05)	(2.99e-05)	(3.21e-05)	(2.94e-05)
roa	0.000997*	0.00106	0.000772	0.000872	0.000983
	(0.000561)	(0.000666)	(0.000570)	(0.000681)	(0.000678)
Constant	-0.145***	-0.112***	-0.150***	-0.112***	-0.109***
	(0.00568)	(0.0101)	(0.00625)	(0.0151)	(0.0150)
N	31,138	31,138	31,138	31,138	31,138
R-squared	0.022	0.036	0.022	0.035	0.036
Industry effects		YES		YES	YES
County effects		YES		YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Table A4 Change in investment for periods 2007-2008 and 2007-2009

Variables	(1) 2007-08	(2) 2007-08	(3) 2007-08	(4) 2007-09	(5) 2007-09	(6) 2007-09
L-leverage	0.0597		-0.248***	0.115**		-0.178***
	(0.0439)		(0.0563)	(0.0438)		(0.0385)
H-leverage	-0.0831**		-0.0188	-0.0735*		-0.0142
	(0.0319)		(0.0558)	(0.0380)		(0.0406)
L-liquidity		-0.154***	-0.187***		-0.140***	-0.134***
		(0.0304)	(0.0341)		(0.0259)	(0.0317)
H-liquidity		0.0869**	-0.0435		0.0973*	-0.118*
		(0.0322)	(0.0633)		(0.0485)	(0.0657)
L-lev*L-liq			0.228***			0.201***
			(0.0729)			(0.0631)
L-lev* H-liq			0.377***			0.426***
			(0.0557)			(0.0537)
H-lev*L-liq			-0.00386			-0.0545**
			(0.0598)			(0.0253)
H-lev*H-liq			-0.0729			0.0712
			(0.166)			(0.0731)
nva	0.0354	0.0428*	0.0388	0.0975***	0.104***	0.0996***
	(0.0265)	(0.0243)	(0.0252)	(0.0258)	(0.0247)	(0.0254)
cfl	0.834***	0.894***	0.825***	1.733***	1.853***	1.726***
	(0.274)	(0.289)	(0.278)	(0.303)	(0.302)	(0.315)
dr	-2.245***	-2.180***	-2.034***	-3.514***	-3.533***	-3.329***
	(0.411)	(0.423)	(0.423)	(0.367)	(0.381)	(0.388)
rsg	-7.23e-05	-5.77e-05	-4.41e-05	2.13e-05	1.11e-05	4.19e-05
	(0.00010)	(0.00011)	(0.00010)	(0.00018)	(0.00018)	(0.00018)
roa	-0.007***	-0.008***	-0.008***	-0.018***	-0.019***	-0.018***
	(0.00190)	(0.00197)	(0.00187)	(0.00236)	(0.00247)	(0.00254)
Constant	0.275***	0.293***	0.341***	-0.170***	-0.141**	-0.106**
	(0.0415)	(0.0468)	(0.0352)	(0.0330)	(0.0506)	(0.0462)
N	17,698	17,698	17,698	17,698	17,698	17,698
R-squared	0.008	0.010	0.011	0.015	0.016	0.017
Industry eff.	YES	YES	YES	YES	YES	YES
County eff.	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Table A5 Change in employment for periods 2007-2008 and 2007-2009

Variables	(1) 2007-08	(2) 2007-08	(3) 2007-08	(4) 2007-09	(5) 2007-09	(6) 2007-09
L-leverage	-0.0084***		-0.00859	0.00618**		-0.000427
	(0.00269)		(0.00672)	(0.00267)		(0.0147)
H-leverage	0.00500**		0.00476	-0.00881		-0.00477
	(0.00233)		(0.00380)	(0.00672)		(0.00984)
L-liquidity		-0.0079**	-0.0143***		-0.0103**	-0.00808
		(0.00341)	(0.00427)		(0.00420)	(0.00989)
H-liquidity		-0.0136***	-0.0127*		0.00366	-0.00249
		(0.00332)	(0.00631)		(0.00466)	(0.00491)
L-lev*L-liq			0.00121			-0.00392
			(0.0177)			(0.0340)
L-lev* H-liq			0.00642			0.00908
			(0.00852)			(0.0109)
H-lev*L-liq			0.00600			-0.00086
			(0.00400)			(0.00591)
H-lev*H-liq			0.00257			-0.0155
			(0.0163)			(0.0206)
nva	-0.0151***	-0.0156***	-0.0154***	-0.0364***	-0.0360***	-0.0367***
	(0.00327)	(0.00326)	(0.00316)	(0.00803)	(0.00802)	(0.00776)
cfl	-0.00245	-0.0102	-0.00355	0.128**	0.135**	0.125**
	(0.0310)	(0.0305)	(0.0306)	(0.0525)	(0.0518)	(0.0528)
dr	0.155***	0.167***	0.164***	0.104	0.102	0.115
	(0.0278)	(0.0280)	(0.0254)	(0.0729)	(0.0691)	(0.0683)
rsg	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
roa	0.0011***	0.0011***	0.0011***	0.00079**	0.00073**	0.00078**
	(0.00034)	(0.00034)	(0.00034)	(0.00029)	(0.00029)	(0.00029)
Constant	-0.0231**	-0.0171*	-0.0170**	-0.054***	-0.053***	-0.051***
	(0.00853)	(0.00910)	(0.00793)	(0.00912)	(0.0122)	(0.0109)
N	31,881	31,881	31,881	31,881	31,881	31,881
R-squared	0.019	0.019	0.019	0.024	0.024	0.024
Industry eff.	YES	YES	YES	YES	YES	YES
County eff.	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors own calculation.

Table A6 Change in investment for periods 2005-2006 and 2005-2007

Variables	(1) 2005-06	(2) 2005-06	(3) 2005-06	(4) 2005-07	(5) 2005-07	(6) 2005-07
L-leverage	0.0942***		-0.141***	0.121***		-0.221***
	(0.0208)		(0.0472)	(0.0250)		(0.0675)
H-leverage	-0.0597*		0.0922**	-0.0609***		-0.00897
	(0.0282)		(0.0408)	(0.0160)		(0.0370)
L-liquidity		-0.243***	-0.237***		-0.222***	-0.304***
		(0.0208)	(0.0506)		(0.0265)	(0.0689)
H-liquidity		0.0246	-0.0623*		0.0610***	-0.139**
		(0.0214)	(0.0332)		(0.0148)	(0.0516)
L-lev*L-liq			0.111			0.358**
			(0.0856)			(0.125)
L-lev* H-liq			0.291***			0.447***
			(0.0630)			(0.0978)
H-lev*L-liq			-0.0969			0.0512
			(0.0703)			(0.0774)
H-lev*H-liq			-0.321**			-0.0189
			(0.128)			(0.0974)
nva	0.0965***	0.103***	0.101***	0.213***	0.221***	0.219***
	(0.0221)	(0.0243)	(0.0263)	(0.0298)	(0.0321)	(0.0325)
cfl	0.259	0.293	0.219	0.607***	0.660***	0.572***
	(0.249)	(0.255)	(0.250)	(0.148)	(0.158)	(0.154)
dr	-1.933***	-1.770***	-1.603***	-2.364***	-2.228***	-2.044***
	(0.161)	(0.170)	(0.180)	(0.135)	(0.144)	(0.154)
rsg	0.00034**	0.0004***	0.0004***	0.000142	0.000174*	0.00019**
	(0.00012)	(0.00012)	(0.00011)	(0.00009)	(0.00009)	(0.00009)
roa	-0.00337	-0.00430*	-0.00397	-0.0086***	-0.0097***	-0.0093***
	(0.00246)	(0.00238)	(0.00230)	(0.00154)	(0.00152)	(0.00145)
Constant	-0.0632	0.00289	-0.00638	0.0373	0.0915*	0.128**
	(0.0394)	(0.0409)	(0.0410)	(0.0470)	(0.0479)	(0.0477)
N	17,254	17,254	17,254	17,254	17,254	17,254
R-squared	0.010	0.013	0.015	0.014	0.017	0.018
Industry eff.	YES	YES	YES	YES	YES	YES
County eff.	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors' own calculation.

Table A7 Change in employment for periods 2005-2006 and 2005-2007

Variables	(1) 2005-06	(2) 2005-06	(3) 2005-06	(4) 2005-07	(5) 2005-07	(6) 2005-07
L-leverage	-0.0113***		-0.0139*	-0.0192***		-0.0244***
	(0.00173)		(0.00702)	(0.00367)		(0.00803)
H-leverage	0.00612**		0.00763	0.000543		-0.000794
	(0.00236)		(0.00443)	(0.00254)		(0.00396)
L-liquidity		-0.000587	-0.00408		0.00105	-0.00518
		(0.00212)	(0.00796)		(0.00341)	(0.00754)
H-liquidity		-0.0047***	0.00549		-0.00440	0.0118*
		(0.00153)	(0.00345)		(0.00275)	(0.00621)
L-lev*L-liq			0.00141			0.00154
			(0.0188)			(0.0157)
L-lev* H-liq			-0.00179			-0.00338
			(0.00777)			(0.0107)
H-lev*L-liq			2.61e-05			0.00735
			(0.0101)			(0.00727)
H-lev*H-liq			0.00774			-0.00272
			(0.0114)			(0.00902)
nva	-0.0265***	-0.0274***	-0.0262***	-0.0443***	-0.0454***	-0.0442***
	(0.00577)	(0.00578)	(0.00579)	(0.00875)	(0.00892)	(0.00873)
cfl	0.0384*	0.0260	0.0406*	0.0506	0.0359	0.0514
	(0.0214)	(0.0211)	(0.0212)	(0.0496)	(0.0493)	(0.0485)
dr	0.116***	0.132***	0.118***	0.176***	0.194***	0.180***
	(0.0206)	(0.0191)	(0.0179)	(0.0445)	(0.0454)	(0.0431)
rsg	0.0002***	0.0002***	0.0002***	0.0003***	0.0003***	0.0003***
	(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00002)	(0.00002)
roa	0.0010***	0.0011***	0.0009***	0.0018***	0.0018***	0.0018***
	(0.00032)	(0.00032)	(0.00033)	(0.00049)	(0.00048)	(0.00048)
Constant	-0.000678	0.000676	-0.000915	-0.000112	-0.00335	-0.000896
	(0.00299)	(0.00334)	(0.00412)	(0.00406)	(0.00578)	(0.00539)
N	28,876	28,876	28,876	28,876	28,876	28,876
R-squared	0.023	0.022	0.023	0.030	0.029	0.030
Industry eff.	YES	YES	YES	YES	YES	YES
County eff.	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: FINA, authors' own calculation.

Table A8 Summary statistics

Variables	(1) N	(2) mean	(3) sd	(4) min	(5) max
employ	18,235	23.10	132.0	1	10,752
cfl	18,235	0.223	0.218	0.00213	1.807
i	18,235	0.189	0.527	4.70e-08	37.86
dr	18,235	0.0860	0.0825	0	0.487
rsg	18,235	28.93	100.6	-70.70	1,567
roa	18,235	15.09	23.55	-22.43	151.0
nva	18,235	0.594	0.565	0.0151	3.871
ten	18,235	0.622	0.274	0.00553	2.005
cr	18,235	2.017	2.073	0.110	17.99

Source: FINA, authors' own calculation.

Table A9 Variance inflation factor multicollinearity test (1/VIF) and Shapiro-Wilk test

Variables	Table 1 (5)	Table 2 (5)	Table A2 (5)	Table A4 (5)	Table A5 (3)
A. VIF					
L-leverage	0.1794	0.1708	0.1851	0.1795	0.1689
H-leverage	0.2823	0.2839	0.2788	0.2801	0.2846
L-liquidity	0.2624	0.2625	0.2606	0.2602	0.2634
H-liquidity	0.2049	0.1991	0.2074	0.2050	0.1968
L-lev*L-liq	0.5370	0.5348	0.5374	0.5278	0.5346
L-lev* H-liq	0.1163	0.1103	0.1198	0.1166	0.1088
H-lev*L-liq	0.1888	0.1868	0.1852	0.1861	0.1874
H-lev*H-liq	0.5854	0.5906	0.5771	0.5744	0.5866
nva	0.5556	0.6099	0.5154	0.5486	0.6119
cfl	0.0365	0.0488	0.0389	0.0399	0.0479
dr	0.2120	0.2703	0.2338	0.2351	0.2670
rsg	0.9176	0.9302	0.9241	0.9133	0.9278
roa	0.0463	0.0618	0.0477	0.0505	0.0609

Table A10 Shapiro-Wilk test for normality of residuals

Specification	Observations	W	V	Shapiro-Wilk
Table 1 (5)	18.235	0.9842	130.697	0.00
Table 2 (5)	31.137	0.9734	339.39	0.00
Table A2 (5)	8.979	0.9871	58.12	0.00
Table A4 (3)	17.698	0.9876	99.96	0.00
Table A5 (3)	31.881	0.8549	1891.13	0.00